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frequently in late embryonic stages. It may be that here, and in other insects whose eggs have a thin chorion, there is need that the egg be coated with saliva to prevent its drying up. Whatever the influence of the secretions of the three pairs of salivary glands, sex in bees is determined by the existence or absence of fertilization. Other conditions within the sex — whether, for example, worker or queen shall result — may be determined (as they apparently also are in termites, according to Grassi's observations) by the quantity and quality of the food, including the salivary secretions. *How* it is that fertilization determines sex is not known, but that it does can no longer be denied.

Dickel has insisted that there is a difference between drones produced by fertile workers and those produced by queens, and he believes that the former are infertile. Weismann says he knows of no proof of this, but admits that the studies of Petrunkewitsch show that there is a slight, though constant, difference in the early phenomena of development between unfertilized eggs from queens and those from workers, and that this may possibly be of importance. Further study on this point is required. A difference between queen-drones and worker-drones is *a priori* in no way improbable; indeed, there is a wasp in which two kinds of drones are known to exist, though it is not known whether these have the same or a different parentage.

M.

Artificial Parthenogenesis. — Following the lead of Morgan and Loeb, who have shown that certain salts can induce the development more or less complete of unfertilized eggs of the sea-urchin, Pieri[1] and Winkler[2] have, independently of each other, tried to induce development of the unfertilized echinoderm egg by means of sperm extract. Their efforts have been at least partially successful, though the observations made are less extensive than might be desired.

Pieri took fresh, sound sperm of *Strongylocentrotus lividus*, or of *Echinus esculentus*, and shook up the same either in sea water or in distilled water. The fluid was then filtered and examined under the microscope. It was found to contain still a certain number of spermatozoa, but these were motionless, rounded, tailless, and, so far as direct observation could show, dead. Unfertilized eggs of the species from which the sperm was obtained were then placed in some of this fluid on a glass slide, and watched under the microscope. A certain number of the eggs developed (without fertilization) up to the morula stage. The fluid was found to be effective in causing the development of unfertilized eggs, even when ten hours old. Control lots of eggs placed in sea water or in distilled water did not develop at all. The sperm extract made in sea water worked better than that made in distilled water, which is not at all surprising considering the known injurious effects of fresh water on marine organisms and their sexual products.

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[1] Pieri, J. B. (**'99**). *Exp.* (3), 7, Notes et revues, *Arch. de Zool.*, p. xxix.

[2] Winkler, H. (**1900**). *Nachrichten v. d. k. Gesellsch. d. Wiss.* Göttingen, *Math.-phys. Klasse*, p. 187.

Pieri admits that his experiments would be more convincing if a centrifugal machine and a porcelain filter had been employed in making the extract. He believes, however, the fact to be established that an extract of spermatozoa contains a chemical substance capable of causing the development of unfertilized eggs of the species producing the sperm. This substance he believes to be a soluble ferment, *ovulase* (Dubois, 1900, *Mémoires Soc. Biol. Paris*, 52, p. 197). No evidence is offered in support of this view.

Winkler's experiments and results are similar, though slightly different methods were employed by him to obtain the extract, and greater precautions were taken to exclude from it living spermatozoa. Sperm of *Sphærechinus granularis* or *Arbacia pustulata* was put into distilled water, shaken frequently during half an hour, and the fluid then filtered five or six times through three thicknesses of filter paper. The fluid was then brought up to the density of sea water by adding to it salt obtained by evaporation of sea water.

Sperm extract was also prepared by putting sperm into concentrated sea water (400 c.c. evaporated to 100 c.c.). In this spermatozoa shrunk at once, but were allowed to stand for half an hour, being frequently shaken. The extract was filtered as already described and then diluted to the concentration of normal sea water.

In the extract obtained by either method a certain number of unfertilized eggs underwent cleavage, though the process was not of the normal sort, and it did not progress beyond the 4-cell stage. Stained eggs showed that genuine mitoses occurred. Control lots which were put into sea water, instead of sperm extracts of the same density, did not develop in any instance.

Only negative results were obtained by heating sperm to 50°–60° C. in sea water and placing eggs in the cooled fluid. Winkler expresses no opinion as to the chemical nature of the extract substance which causes the development of unfertilized eggs, but thinks the idea of

Pieri and Dubois that it belongs to the enzymes lacking in support as yet.

The observations which have just been briefly summarized add to the accumulating evidence that fertilization may be essentially a process of stimulation of the egg. This, of course, is true only if one leaves out of account the contribution of hereditary tendencies made by the spermatozoön, which add to the variability of the offspring. The egg, however, apparently contains everything necessary for the production of a new and complete organism like the mother, and needs only appropriate stimulation to start it on its course of development (see Koulagine, 1898, *Zool. Anz.*, 21, p. 653; also Delage, 1900, *Archives de Zool., Exp.* (3), 7, p. 525). In this direction point also the observations of Tichomirov, who showed that the unfertilized eggs of *Bombyx mori* can be made to develop, at least to an advanced embryonic stage, either by dipping them in sulphuric acid or by brushing them; likewise the observations of Dewitz, who obtained cleavage of unfertilized frog's eggs by treating them with corrosive sublimate; likewise the observations of Hertwig, who observed a similar result following the treatment of sea-urchin eggs with strychnine; further, those of Koulagine (already cited), who has induced cleavage of certain fish and amphibian eggs by treating them with the antitoxin of diphtheria; and those of Klebs, who found that parthenospores are formed in conjugating filaments of Spirogyra, in the presence of salt or sugar solutions of appropriate density. Still more emphatically is this indicated by the recent work, already mentioned, of Morgan, and especially of Loeb.

W. E. C.

PETROGRAPHY.

Graphic Representation of Rock Composition and Schemes of Rock Classification. — The recent great increase in our knowledge of rocks and the complexity of their chemical relationships is responsible for the attempts now being made to indicate by graphic methods these relations and incidentally to classify rock magmas on some chemical basis. The differential hypothesis was intended to explain the cause of the chemical relations existing between rock masses. It cannot serve, or at any rate it has not served, as a basis for rock classification. Rocks as objects of study are but portions of differentiated masses. A rock classification must deal with these portions, and it must necessarily deal with well-characterized portions or